



A WR-3.4 InP HBT Power Amplifier Using Slot Power Combiner

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Introduction

Advantages of the THz Band:

- Wide frequency range allows for the application of ultra-high-speed wireless communication systems.
- Suitable for various applications such as radar, imaging systems, and optical signal processing.

The needs of power amplifier (PA)

- To apply the aforementioned applications, a high-output power source is necessary.
- There is a need for low-loss and wideband power combining structures to enhance power output.

Design

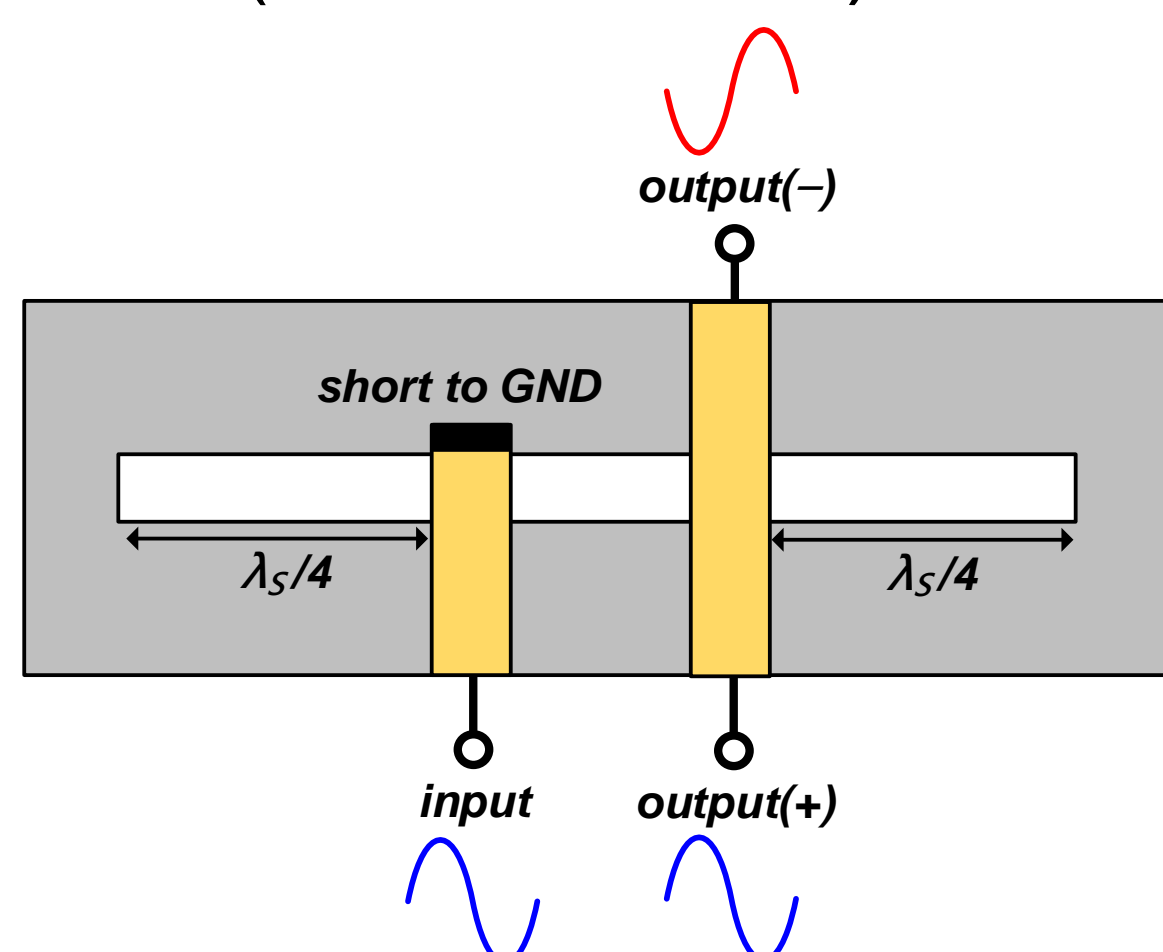
Slotline Balun design

- The Slotline Balun is designed to effectively minimize the imbalance of differential signals by removing the even-mode components. It addresses issues such as oscillation and gain reduction.
- At 270 GHz, the insertion loss is 1.8 dB. By eliminating pad losses, each balun has an insertion loss of 0.7 dB. Additionally, it exhibits excellent insertion loss characteristics of 1.1 dB or less across the entire WR-3.4 frequency band.

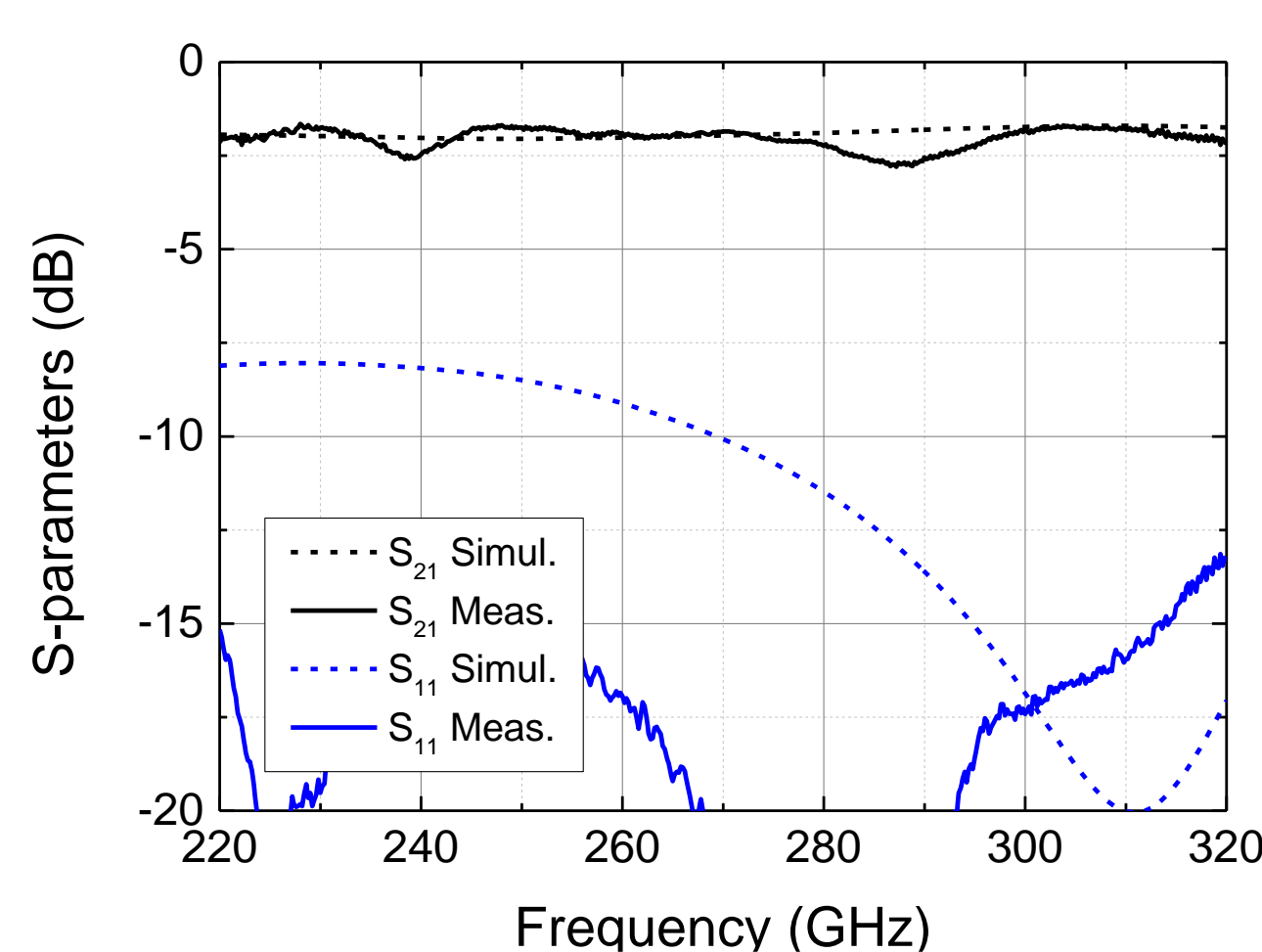
2-chain CB PA design

- The 2-Chain CB PA is constructed by parallelly connecting two stages of CB amplifiers to enhance the output power (P_{sat}).
- The self-biasing technique simplifies the DC biasing by allowing for easy biasing.

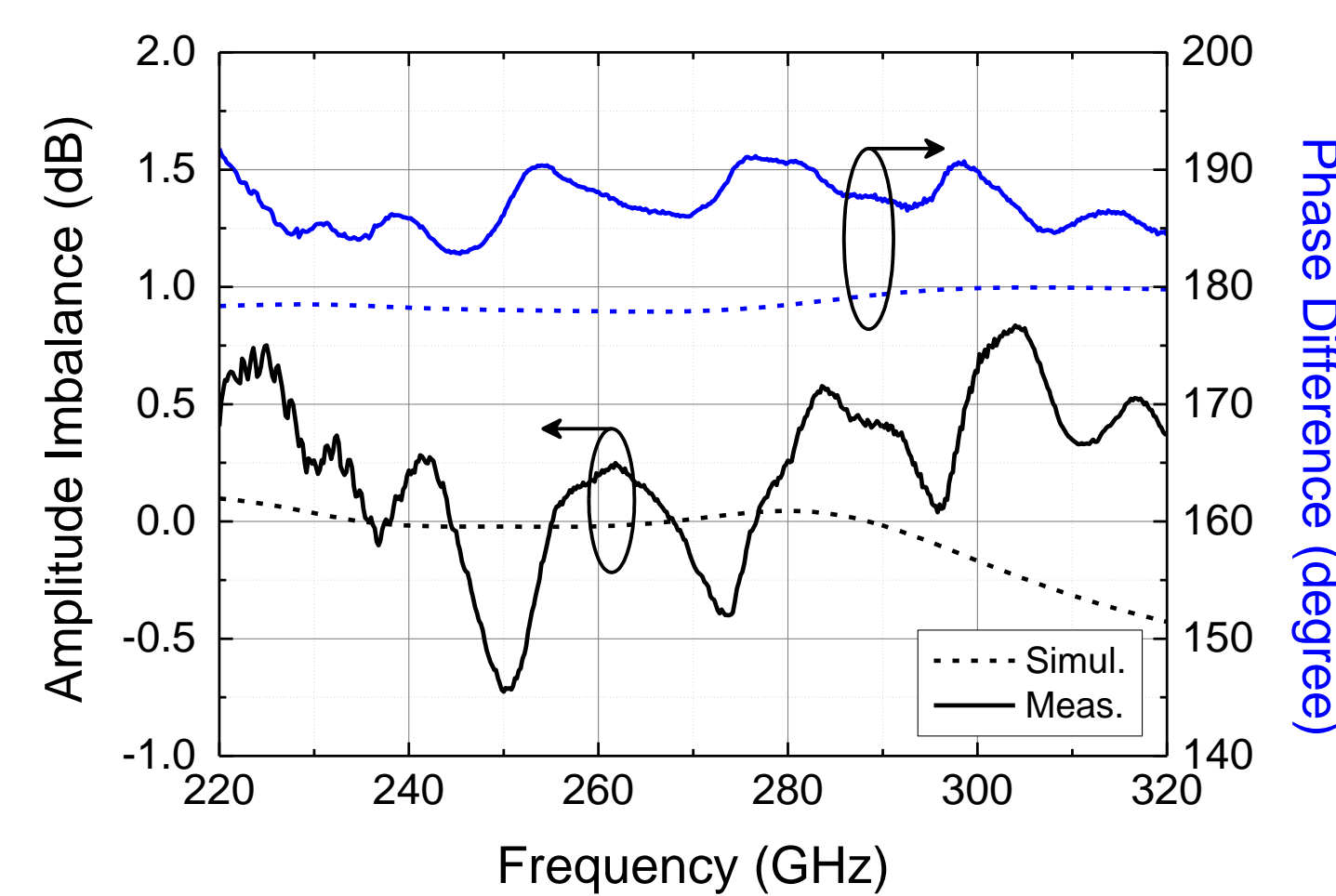
(Slotline balun)



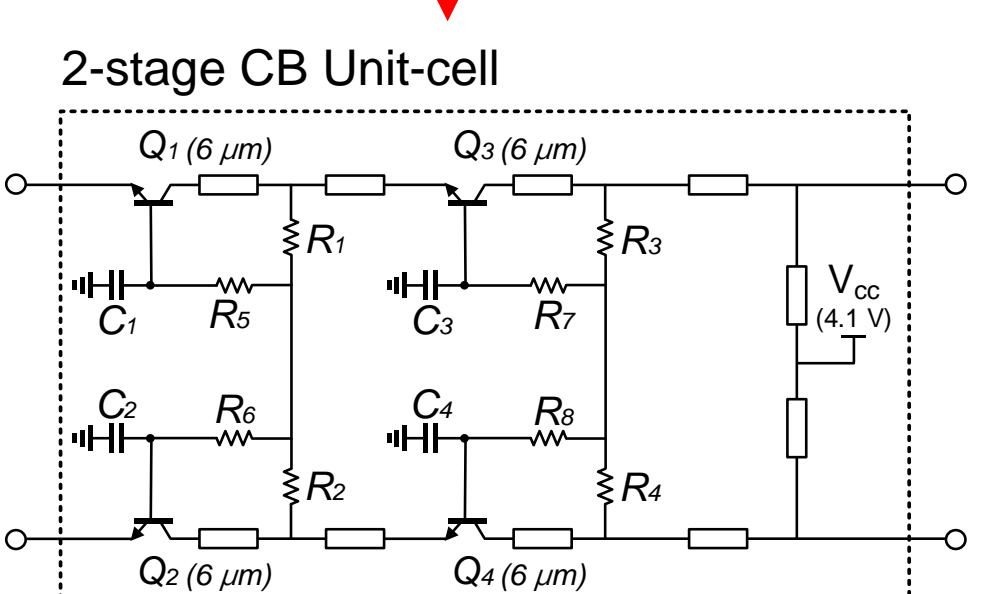
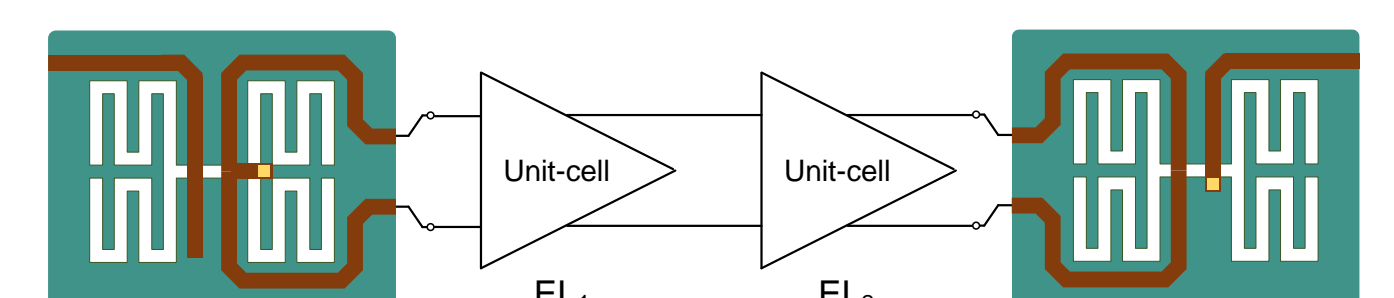
(S-parameters)



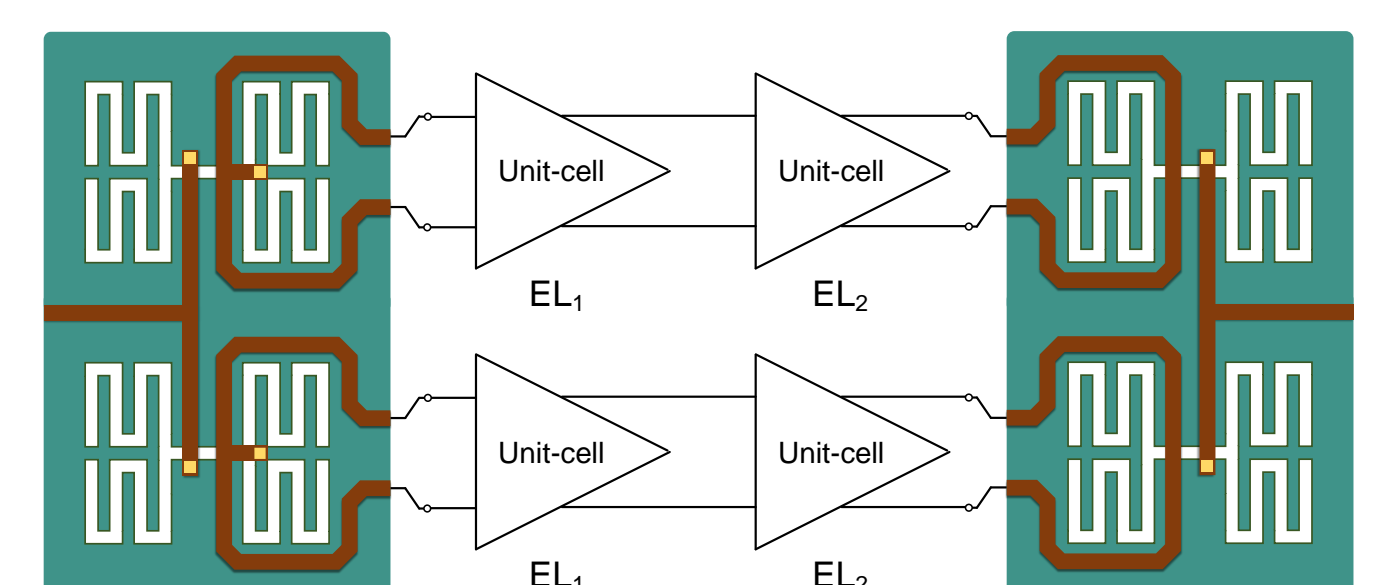
(Signal balance)



(1-chain CB PA)



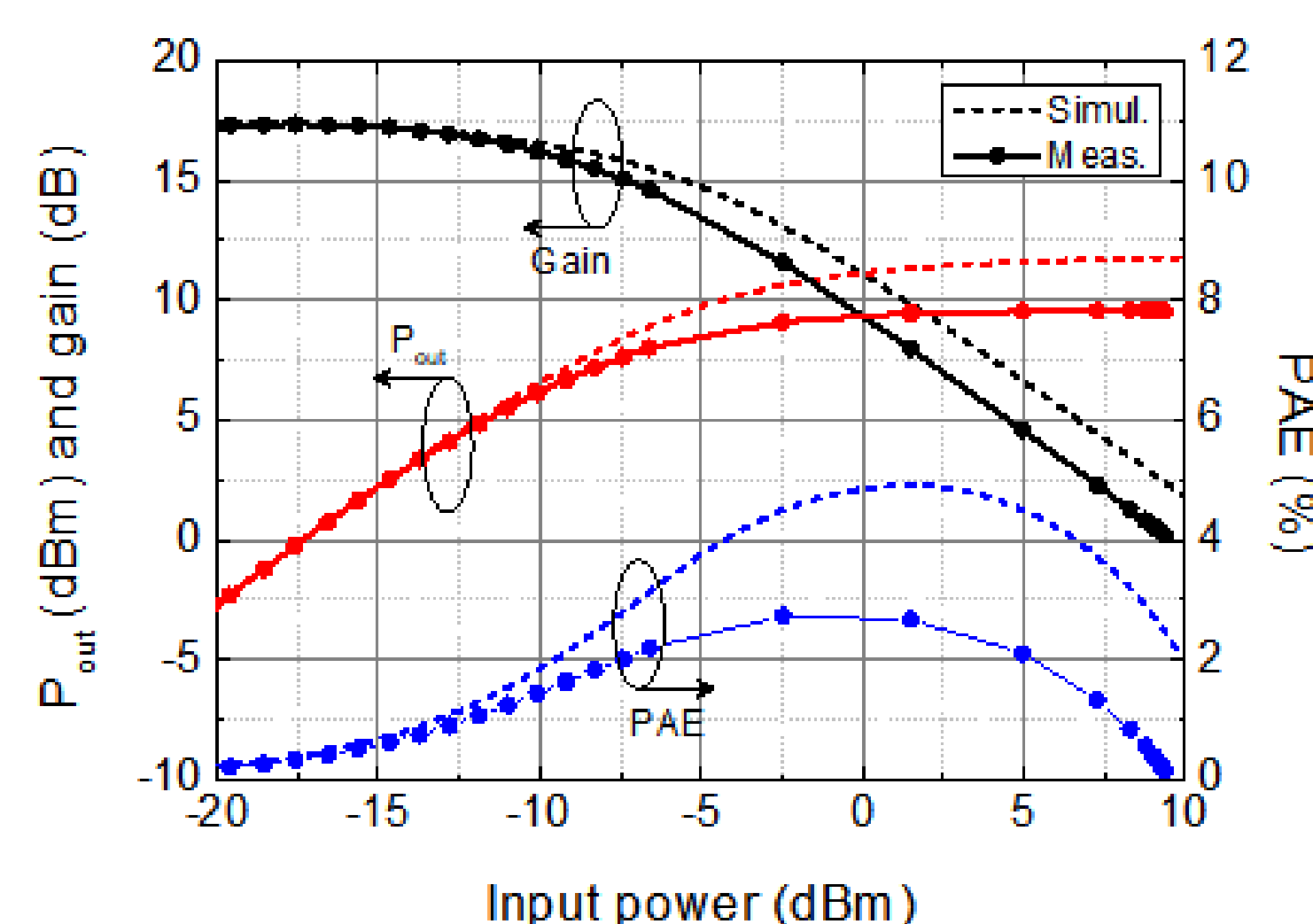
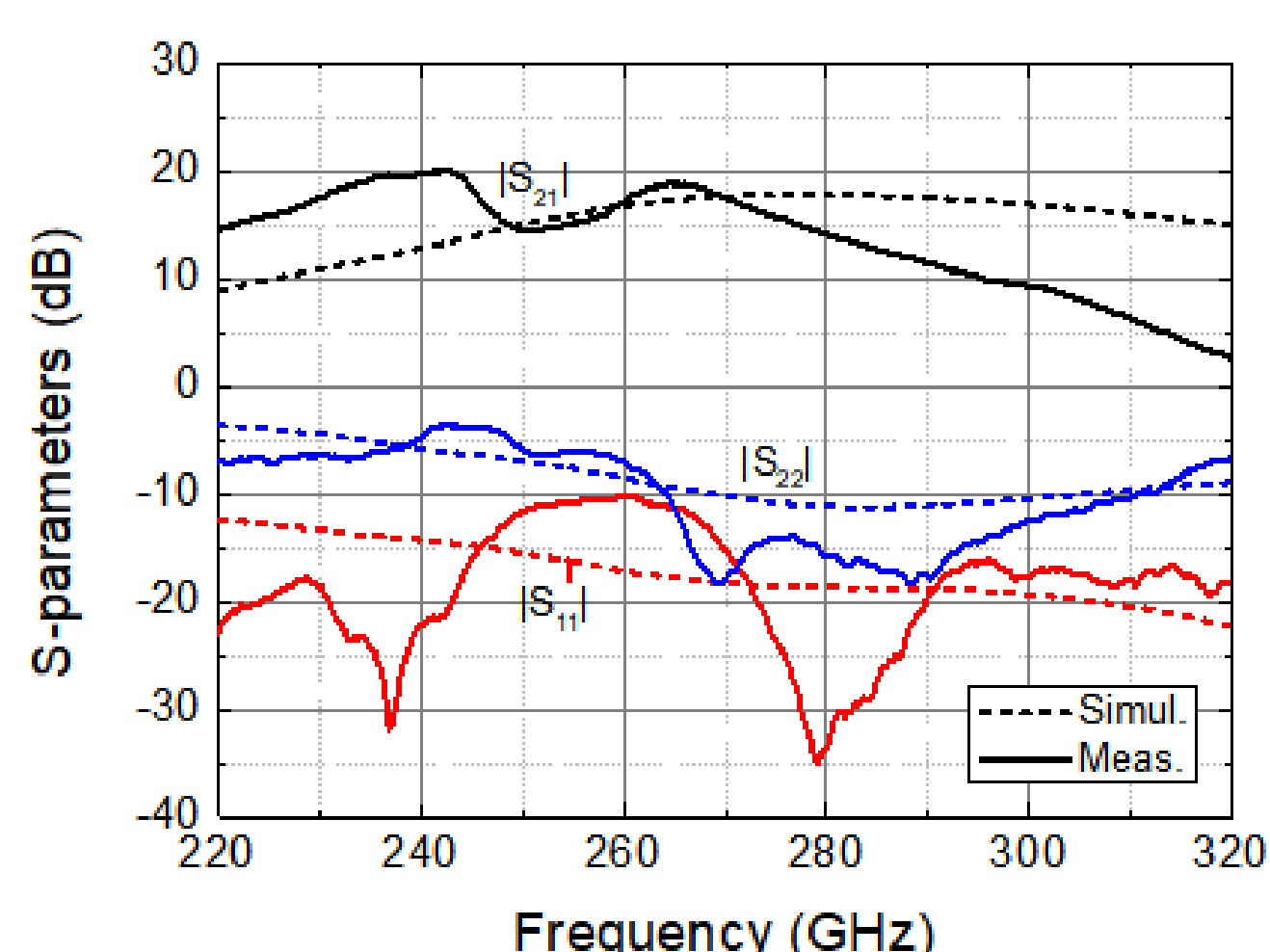
(2-chain CB PA)



Results

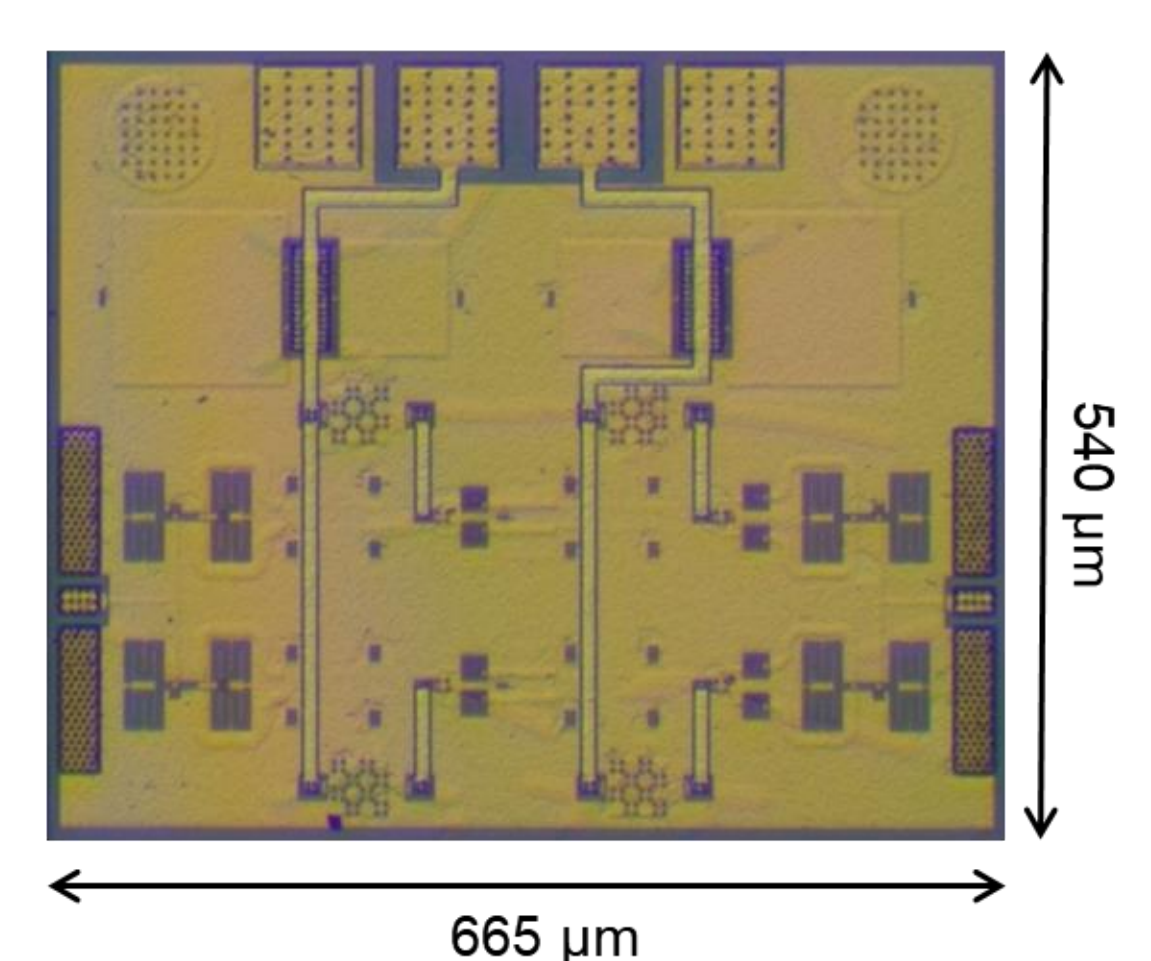
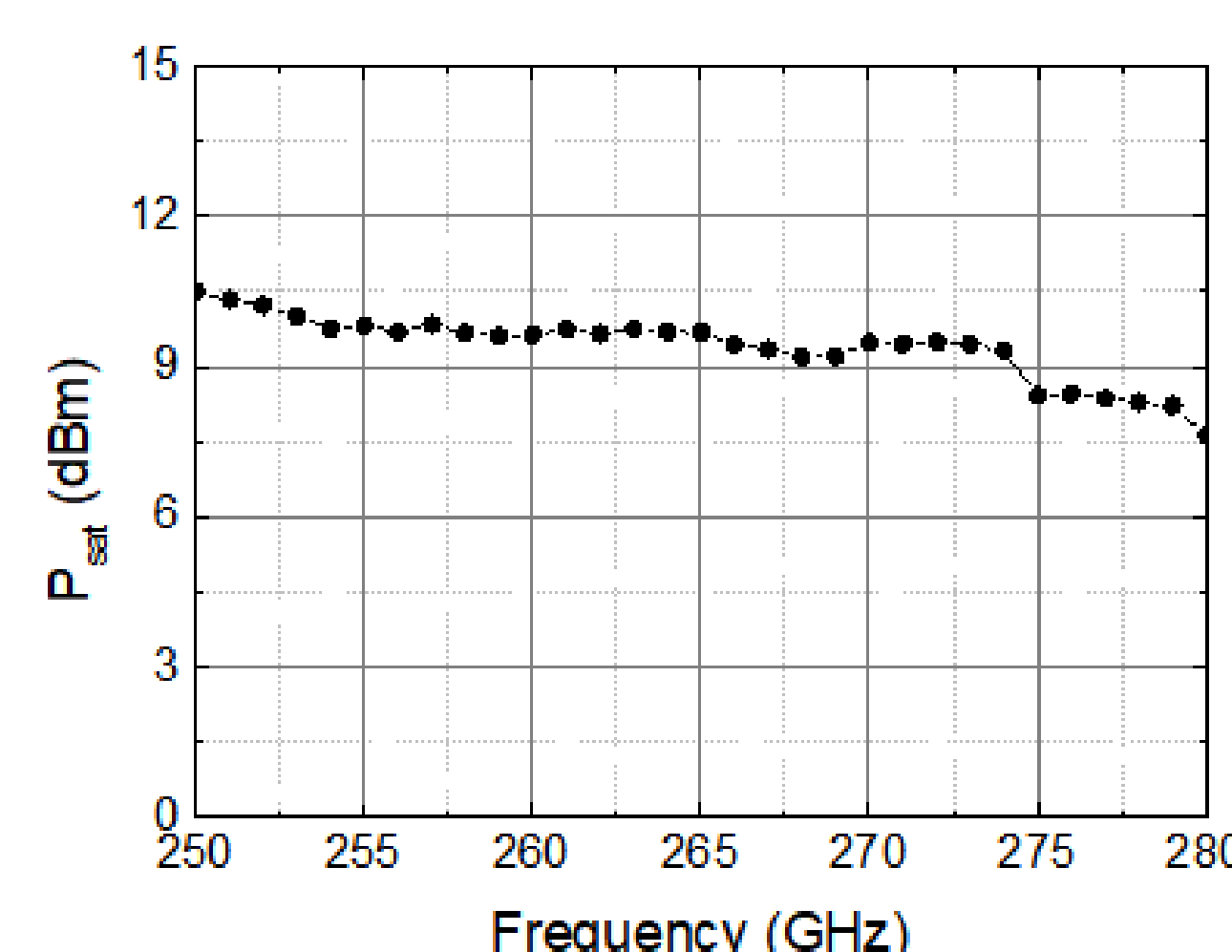
S-parameters measurement

- $S_{21} = 12.2$ dB @ 270 GHz
- 3-dB BW > 62 GHz (> 24.7 %)



Power performances

- Output power : 9.6 dBm @ 270 GHz
10.5 dBm @ 250 GHz
- Peak PAE : 2.7 % @ 270 GHz



Conclusion

- We have developed a slotline-based power amplifier using the InP HBT process.
- The PA demonstrates high output power, with 9.6 dBm at 270 GHz and 10.5 dBm at 250 GHz

The chip fabrication and EDA tool were supported by the IC Design Education Center(IDEC), Korea